Theoretical and Experimental Studies in Aerospace Sciences

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A multidisciplinary research effort was implemented in this grant. The first part involved studying experimentally two different but related flow fields; the 2-D backstep and a 3-D corner flow. The second part involved gaining a fundamental understanding of the behavior of large flexible space structures and its light subsystems under a variety of microgravity loading conditions.

- 2-D backstep and 3-D corner flow - Sheldon Stokes was supported as a NASA Grad Aero fellow from April 1, 1993 - June 30, 1995. Sheldon used Langley's 3 component LDA system to perform measurements in Langleys 2-D backstep flow facility. He completed a major set of experiments which are currently available for turbulence model development. These measurements include all three components of velocity. From these data, up to 4th order moments were calculated and energy balances performed from the kinetic energy equation. From this balance an idea of the spatial behavior of the turbulent dissipation was obtained. He also made LDA measurements very near the step for comparison to PIV data taken in the same facility. This set of data can be used as a check on the PIV data. The facility was then modified to a 3-D corner flow. This flow involves adding a streamwise step in the backstep facility. This flow has the unique characteristic of being three dimensional in the region of the corner but relaxes to a 2-D backstep and a 2-D channel in the two spanwise limits. This makes it attractive from an analytical point

of view. An initial set of LDA measurements was obtained in this configuration under this grant and presented at the turbulent shear flows meeting at Penn State in August of 1995. Sheldon finished his MS thesis in the summer of 1995 and has continued on for his Ph.D. under support from NASA/Langley through the GSRP program.

- Gina Lee-Glauser was a NASA Grad Aero Fellow from June 1, 1993 - May 15, 1994. Gina examined the effectiveness of an active vibration absorber (AVA) for vibration suppression of large flexible space structures. She used NASA Langley's Controls-Structures Interaction phase II evolutionary model, housed in the Structural Dynamics Branch, for this purpose. The AVA was used to control random excitation on the flexible model itself (from its 8 actuators) as well as from outside disturbances such as gimbals. These results showed that the AVA can reduce the open-loop response by as much as 40%. The AVA also demonstrated that it is a powerful controller for disturbance rejection. Gina also studied passive control schemes for protection of payloads from orbiter lift-off excitations (both stochastic and deterministic). System performance with and without the passive vibration control systems were also analyzed. Gina finished her Ph.D. in May of 1994. Out of this work at least 3 journal articles and several conference papers were published jointly with NASA/Langley personal. After finishing her Ph.D. Gina joined NASA/Langley in the Structural Dynamics Branch as an NRC Fellow from June, 1994 - December 1995. She then returned to Clarkson University as a Research Assistant Professor in Mechanical and Aeronautical Engineering and in August of 1996 she was appointed as Associate Director for Research.